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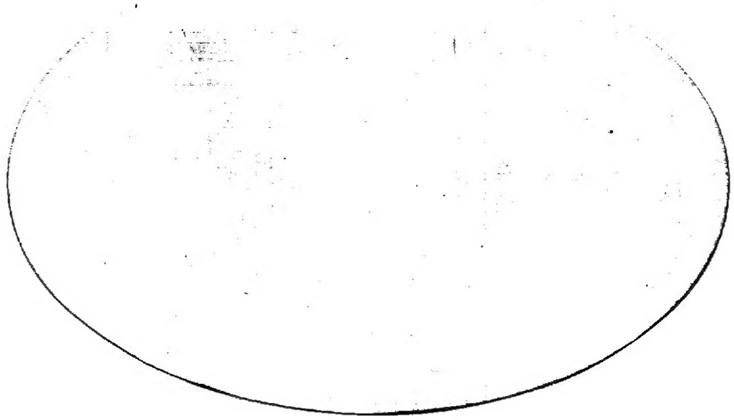
Stabilized Binocular Scope

10X-20X   200-Navy.

[redacted]



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TECHNICAL PROPOSAL
FOR
A
DIRECT IMAGE STEREO VIEWER

July 11, 1968

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1.0 INTRODUCTION

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In 1963, [redacted] proposed and developed the Model DV550 Direct Image Viewer, under a government contract. The DV550 was the first real breakthrough in direct image viewing, combining in one instrument the excellent image quality of a microscope and the observation ease of a rear projection system.

In direct viewing optical instruments, such as a microscope, the exit pupil is small, requiring that the operator place his eye close to the eye piece for satisfactory viewing. The present Model 550 Direct Image Viewer, with its large optical elements and diffraction grating, enlarges the exit pupil in a manner that the operator may view with both eyes the image and still have adequate head movement. In the absence of employing diffraction gratings in the present viewer, a single small exit pupil would exist, which would restrict the operator to the use of a single eye and no head movement when viewing at high magnifications. Through the insertion of the gratings in the optical path, many exit pupils are created, which when arranged side by side and placed both above and below one another, form a matrix of exit pupils in space providing an effective viewing area of 3.5 inches square, where the operator may place his eyes for viewing. This unique approach results from the use of a special field lens, and specially designed and built set of diffraction gratings. The basic principles employed in the Model 550 have been experimentally demonstrated as being applicable to direct image stereo viewing.

In the Model 550, one primary exit pupil was enlarged to form an exit pupil matrix for monocular viewing. By the use of two objective lenses and adjacent stereo frames on the film, two primary exit pupils are formed for stereo viewing.

The Direct Image Stereo Viewer described in this document is therefore proposed as a practical approach to the design of the next generation of direct image viewing equipment.

2.0 EQUIPMENT DESCRIPTION

2.1 General

The overall design of the Stereo Viewer will in some respects be similar to the Model 550. These similarities are primarily in parts of the basic optical system and the use of identical optical components such as the diffraction gratings, field lens, and field flatteners. The remainder of the unit will require a complete redesign to provide a more compact package and the inclusion of additional optical components. The film transport system will also be redesigned to provide the capability of field area coverage of 5-inch film and a means of compensating for varying percentage of overlap. Sections 2.2 through 2.3 contain a brief description of the two major elements of the stereo system, i.e., film translation and optical.

2.2 Film Translation

Since the exit pupils are images of the projection lens aperture and the position of the exit pupil must remain fixed, the projection lenses cannot move. The spacing between the lenses is also considerably greater than the spacing between the adjacent 5-inch transparencies.

The proposed method of compensating for this spacing difference and % overlap correction is illustrated in Figures 2a and 2b. The two prisms allow the lenses to scan images which are much closer together than their own centers. Then, by rotating the prisms around each projection lens centerline, the 2-inch minimum viewing distance can be increased to 5 inches. (See Figure 2a)

The prisms are rotated by turning a Stereo Convergence Adjustment knob. To provide greater optical centerline separation, the film is also moved as the prisms are rotated to keep the same film area (Y axis) in the viewing field. Since the film must be moved in the vertical (Y) and horizontal (X) axis for viewing the entire frame, additional movement in the vertical axis will accomplish the desired task.

To accomplish scanning movements in the vertical direction, the entire platen, illumination and film transport is moved. The condenser system will move in relation to the prisms, since the centerline of these prisms represents the optical line of sight at all prism positions.

For lateral (horizontal) movements of the film for viewing of the entire frame, the vacuum platen is moved $\pm$ 2¼ inches by a small motor and drive system. (See Figure 2b.) This movement mechanism rides on the previously mentioned vertical movement system.

A torque motor will be attached to each spool to allow the film to be driven in either direction. The vacuum applied to the platen will be released when the film transport control is used.

2.3 Optical System

2.3.1 The 5X objective lenses are commercial lenses with a 210mm focal length and are used with an aperture of approximately f/4. A total focusing adjustment of 1/8 inch is provided for each lens.

2.3.2 Field lens - A 16" diameter field lens is used to image the aperture of the objective lenses in front of the viewer as

an exit pupil. The diffraction grating is mounted between the two field lens elements. A two dimensional array of exit pupils is created by the grating, the diffraction occurring with reasonably uniform transmission over ±13 orders to provide the 3.5 inch exit pupil matrix.

The field lenses form a real image of the imaging lens pupil at a nominal distance of 20 inches from the field lenses and grating assembly. The field lenses are also designed so that the light incident upon the grating is substantially parallel and that adjacent diffracted pencils of light abut in the exit pupil plane.

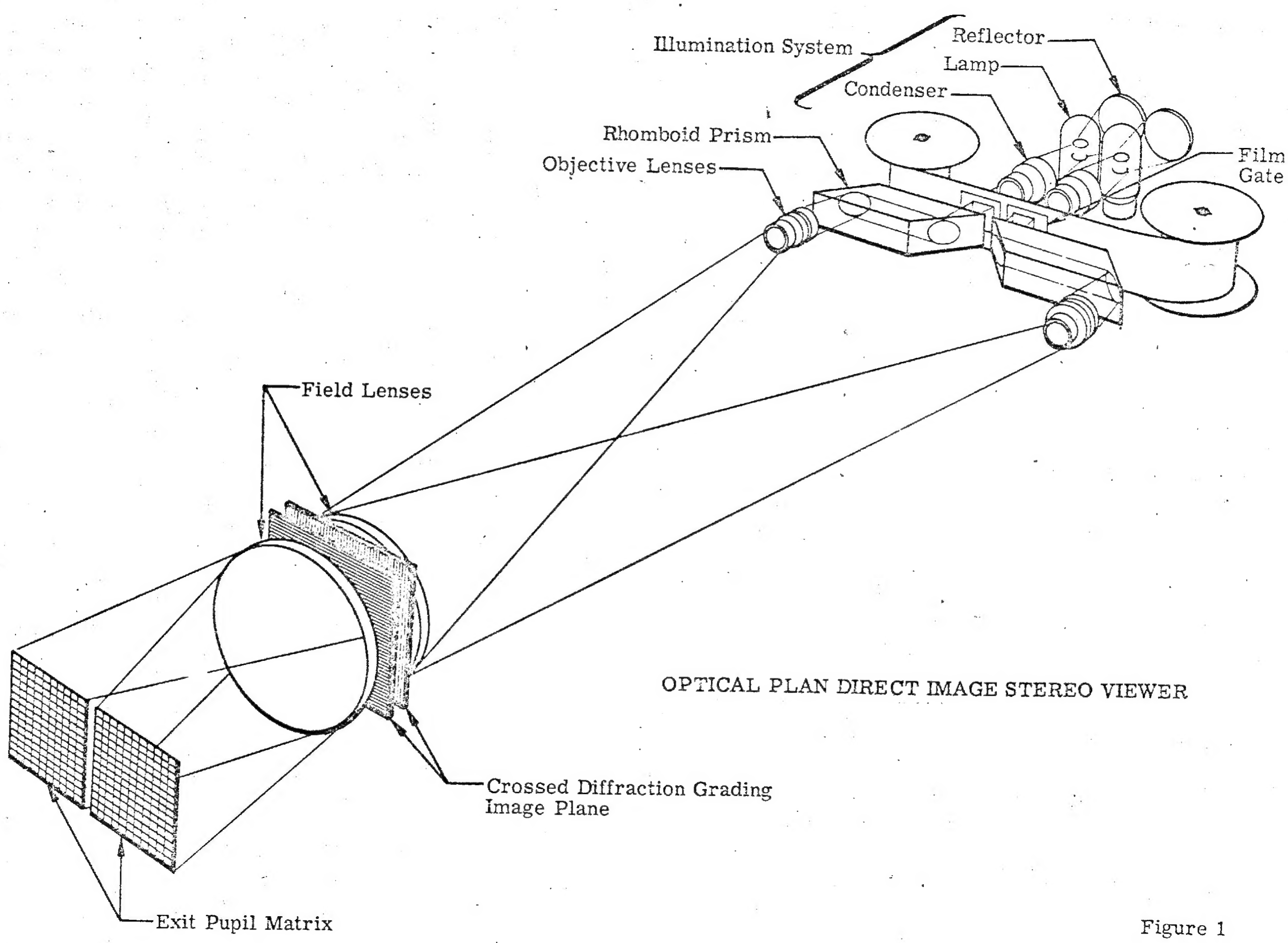
The part of the field lens assembly preceding the grating has a front focal point located in the exit pupil of the imaging lens, and is corrected for asymmetry errors. That is, for every point of the imaging lens aperture includes equal but opposite angles with the axis of the system.

The single element preceding the grating in the field lens assembly causes a slight curvature of the image which must be compensated in order to project a flat image onto the grating. The compensation is effected by placing a field flattener close to the object plane. The power of this lens is almost equal to the power of the single element in the field lens assembly, but it has the opposite sign.

2.3.3 Light source - Two 500 Watt, air-cooled lamps are used to provide the required illumination. Controls provided to allow brightness adjustment.

3.0 SUMMARY OF CHARACTERISTICS

Magnification:	5X
Observable Film Area	2" x 2" at 5X
Film Size:	5" wide roll film up to 500 feet long
Exit Pupil Size:	Each 3.5" square
System Resolution:	50 l/mm AWAR at film plane
Light Intensity:	Illuminance equivalent to a 500' lambert diffusion screen
Film Positioning:	Remote X and Y translation permitting full area coverage
Focusing:	Fine manual focusing provided for each lens.
Viewer Controls:	Main Power - ON/OFF
	Lamp - ON/OFF
	Illumination Intensity
	Lens Focus
	Film Translation 4½" in the Y axis
	Film Transport - forward/reverse
	Stereo Convergence Adjustment



OPTICAL PLAN DIRECT IMAGE STEREO VIEWER

Figure 1

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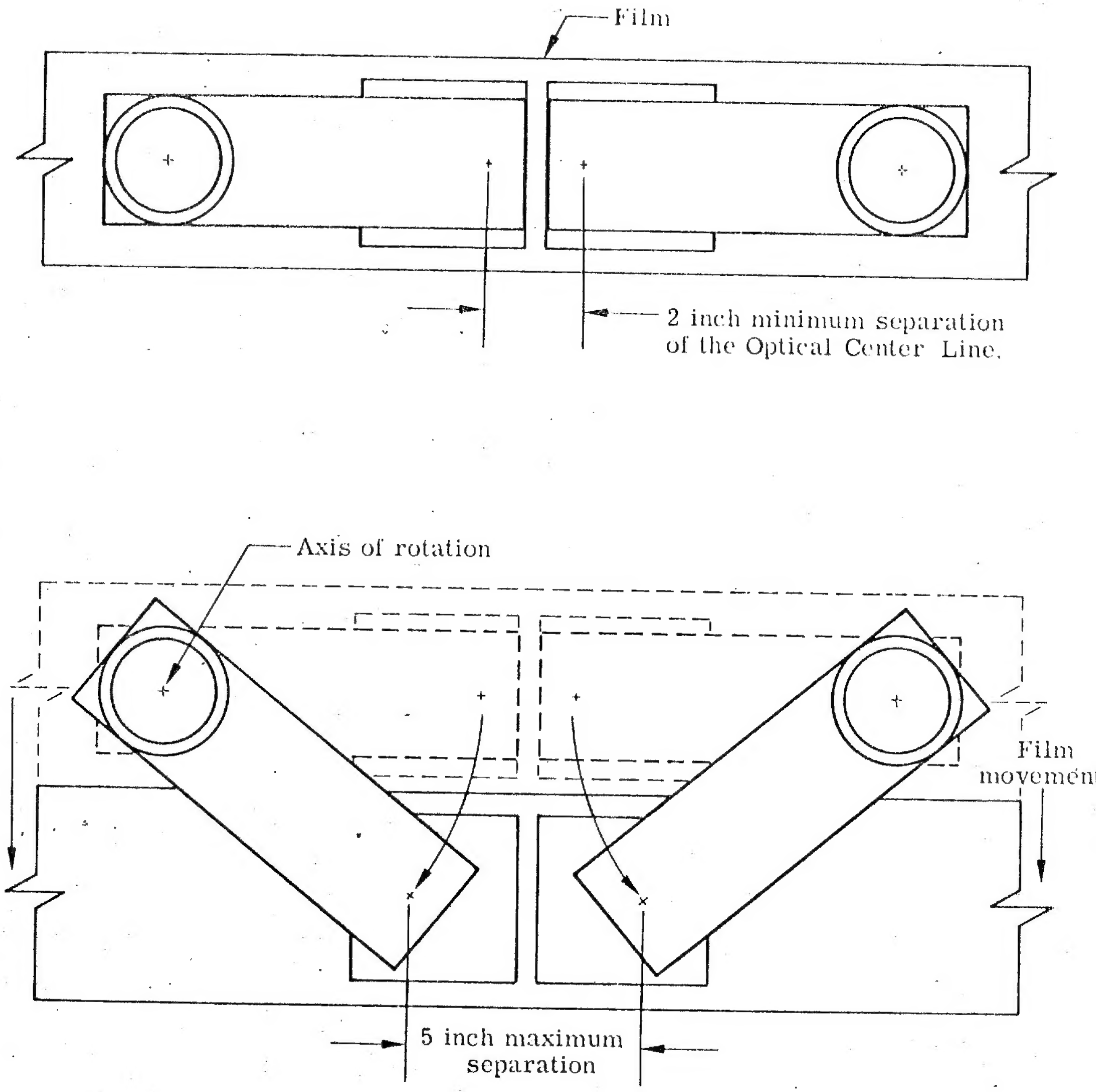
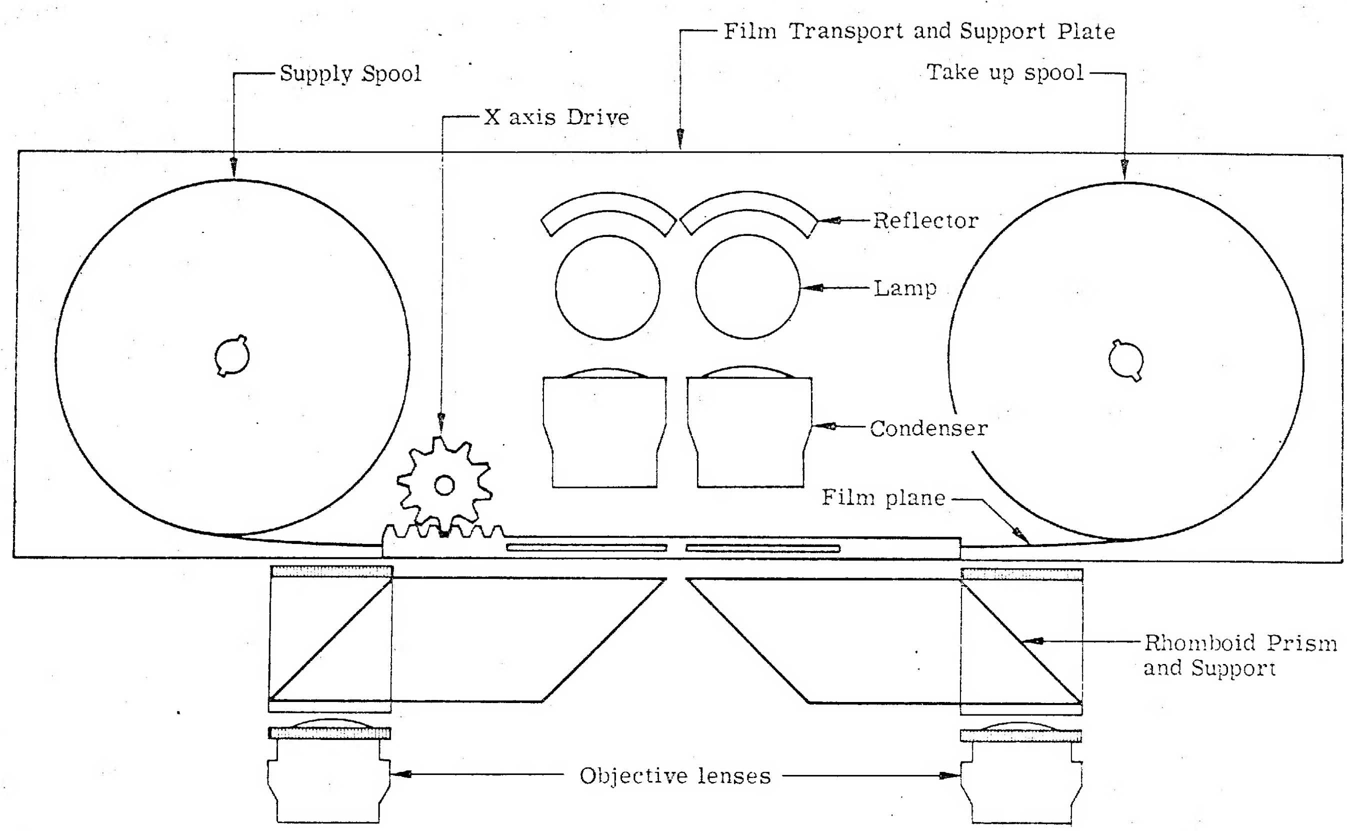


ROTATING PRISMS TO VARY STEREO BASE

Figure 2a



TOP VIEW OF FILM TRANSPORT & PROJECTION ASSEMBLY

Figure 2b

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